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(54) Title of the invention: Surface Observation Device for Plate-Like Member(57) AbstractPurpose: To easily detect and observe uneven defects of a plate-like member.

Configuration: There is provided a surface observation device for a plate-like member of which a pair of arm members 1a and 1b is superimposed on each other with a gap therebetween and one end of the arm members are joined to each other. The surface observation device observes the surface of a plate-like member, which is inserted into the gap, through the other end of the arm members. Observation windows 2a and 2b, which are provided with lenses 3a and 3b, are formed at the same position on the other end of the arm members. A surface defect, which is detected through the observation window 2a positioned on the surface side and for which the position thereof is determined, is observed and confirmed through the observation window 2b positioned on the back side.

Scope of Patent Claims

Claim 1

A surface observation device for a plate-like member of which a pair of arm members (1a, 1b) is superimposed on each other with a gap therebetween and one end of the arm members are joined to each other, and which observes the surface and back surface of a plate-like member (S) inserted into the gap through the other end of the arm members,

wherein observation windows (2a, 2b) are formed at the same position on the other end of the arm members (1a, 1b).

Claim 2

The surface observation device for a plate-like member according to claim 1, wherein the arm members (1a, 1b), which are provided with the observation window (2a, 2b) at the same position, are locked to a fulcrum member (5) so as to be movable in a longitudinal direction and rotated parallel to the surface of the plate-like member.

Claim 3

A surface observation device for a plate-like member of which a pair of arm members is superimposed on each other with a gap therebetween and one end of the arm members are joined to each other, and which observes the surface and back surface of a plate-like member (S) inserted into the gap through the other end of the arm members, the surface observation device comprising:

a first rail (8);

a second rail (11) that is orthogonal to the first rail;

a first block (7) that slidably moves on the first rail (8);

a second block (10) that slidably moves on the second rail (11);

a first arm (6) that is provided on the first block (7) in a direction orthogonal to the first rail (8) and includes a slit (61) having the same width over substantially the entire length thereof; and

a second arm (9) that is provided on the second block (10) in a direction orthogonal to the second rail (11) and includes a slit (91) having the same width over substantially the entire length thereof,

wherein an observation window (2) is formed at an intersection between the first arm (6) and the second arm (9).

Claim 4

The surface observation device for a plate-like member according to any one of claims 1 to 3, further comprising:

a lens (3) that is provided at the observation window (2).

Detailed Description of the Invention

[0001]

Industrial Field of Utilization

The present invention relates to a device for detecting and observing a fine defect generated on, for example, a cold-rolled steel sheet, and more particularly, to a device for detecting an uneven defect, that is, a defect that is generated on one surface of a plate-like material to be checked and seems to be defective even when seen from the other surface thereof, by easily comparing defects generated on each surface, and observing the uneven defect.

[0002]

Prior Art

In a process for manufacturing, for example, a cold-rolled steel sheet, a strip-shaped steel plate is subjected to various treatments and is shipped in the form of a cold-rolled coil or a cold-rolled sheet. Further, at various stages of the process, a surface defect is visually checked by an automatic defect detecting device or an operator, so that the surface quality is managed.

[0003]

As one type of surface defect in a cold-rolled steel sheet, there is an uneven defect that is caused by slight unevenness on the surface of a steel plate. However, this kind of defect is generally undetectable by the naked eye. Accordingly, a so-called grindstone check method is generally employed that visually checks a defect after making the defect clear by slightly grinding the surface of a steel plate by a grindstone. An example of a surface defect, which is detected by a grindstone check, is shown in Fig. 5. Reference character R denotes a roller, reference character D denotes a foreign material that is attached to the surface of the roller, and reference character S denotes a plate-like member such as a steel plate.

[0004]

If a foreign material D is attached to the surface of the roller R, a portion of the steel plate S coming into contact with the roller is pushed up by the foreign material D. Accordingly, in Fig. 5, the back surface of the steel plate is recessed and the surface of the steel plate protrudes so as to have a convex shape. A contact mark of the back surface coming into contact with the roller should be detected in order to determine the cause of the generation of the defect and take appropriate measures. However, in general, the contact mark is a fine mark that is formed by the pricking of a needle tip. In particular, if the surface of a steel plate is not a mirrored surface but a surface on which fine surface unevenness called a dull finish is formed, it is difficult to detect a defect due to the unevenness. Accordingly, instead of a method of detecting a fine concave defect, there is employed a method of catching convex portions of the surface by making the convex portions of the surface become obvious by a grindstone check and finding a defect by observing the back surface.

[0005]

In the past, for this purpose, the following method has been performed. In this method, a pincette-shaped device is held so that a steel plate is nipped by the pincette-shaped device; an end, which is positioned on the surface side, of the device is positioned at a position of a defect; and a defect of the back surface of the steel plate is detected at a position that is indicated by the end, which is positioned on the back surface, of the device. However, since the ends of the pincette-shaped device cover a fine defective portion in this method, there are problems in that it is not possible to directly observe the defective portion and it is difficult to specify the size and shape of the foreign material causing the generation of the defect.

[0006]

Problems to Be Solved by the Invention

The invention has been made to solve the above problems, and an object of the invention is to provide a surface observation device for a plate-like member that can easily detect a defective portion and sufficiently observe the defective portion.

[0007]

Means to Solve Problems

According to the invention of claim 1, there is provided a surface observation device for a plate-like member of which a pair of arm members is superimposed on each other with a gap therebetween and one end of the arm members are joined to each other and which observes the surface and back surface of a plate-like member inserted into the gap through the other ends of the arm members. Observation windows are formed at the same position on the other end of the arm members.

[0008]

According to the invention of claim 2, in the surface observation device for a plate-like member according to claim 1, the arm members, which are provided with the observation windows (2a, 2b) at the same position, are locked to a fulcrum member so as to be movable in a longitudinal direction and rotated parallel to the surface of the plate-like member. According to the invention of claim 3, a surface observation device is provided for a plate-like member of which a pair of arm members is superimposed on each other with a gap therebetween and one ends of the arm members are joined to each other and which observes the surface and back surface of a plate-like member inserted into the gap through the other ends of the arm members. The surface observation device includes a first rail, a second rail that is orthogonal to the first rail, a first block that slidably moves on the first rail, a second block that slidably moves on the second rail, a first arm that is provided on the first block in a direction orthogonal to the first rail and includes a slit having the same width over substantially the entire length thereof, and a second arm that is provided on the second block in a direction orthogonal to the second rail and includes a slit having

the same width over substantially the entire length thereof. An observation window is formed at an intersection between the first arm and the second arm.

[0009]

Further, according to the invention of claim 3, the surface observation device for a plate-like member according to any one of claims 1 to 3 further includes a lens that is provided at the observation window.

[0010]

Action

According to the invention, arm members having the same dimensions are superimposed on each other, one end portions of the arm members are jointed to each other, and observation windows are formed at the other ends of the arm members. Accordingly, the observation windows, which are positioned on the surface side and back side, are always provided at the same position on both the surface side and back side of the plate-like member. Therefore, it may be possible to detect and catch a surface defect on the other surface of the plate-like member that is difficult to be detected, from a surface defect on one surface of the plate-like member that is easily detected. Further, if lenses are mounted on the observation windows, it may be possible to enlarge a fine defective portion and to observe the fine defective portion and it may also be possible to easily detect a defect that is buried in dull-finished fine unevenness.

[0011]

Embodiments

First embodiment

A first embodiment of the invention is shown in Fig. 1. Fig. 1 is a perspective view of a surface position indicating device according to this embodiment. Reference numerals 1a and 1b denote arm members, reference numerals 2a and 2b denote observation windows, reference numerals 3a and 3b denote lenses, and reference numeral 4 denotes a joint. Reference numerals 1a and 1b denote a pair of arm members having the same dimensions, the positions of the arm members are superimposed to fit on each other with a gap therebetween, and one end of the arm members are joined to each other as the joint 4 in the shape of a pincette. Observation windows 2a and 2b are formed at the same position on the other end of the arm members 1a and 1b opposite to the joint 4, and lenses 3a and 3b are fitted to the observation windows, respectively.

[0012]

An example of use of the surface position indicating device according to this embodiment will be described with reference to Fig. 2. A plate-like member S is inserted into a gap between the arm members 1a and 1b, and a defective portion, which becomes conspicuous on the surface of the plate-like member S by a grindstone

method or the like, is detected and caught through the observation window 2a or the lens 3a while the entire device is held and moved by hand. In this case, the other observation window 2b is provided at the same position as the defective portion on the back side of the defective portion. Accordingly, the back surface of the plate-like member S is observed through the observation window 2b or the lens 3b, so that it may be possible to detect a fine defective portion.

[0013]

Since having a simple structure, a surface observation device of this embodiment is easily handled. However, when a defect is detected on the surface, there is a slight drawback that an effort is required to hold the entire device at the position corresponding to the defect.

Second embodiment

A second embodiment of the invention is shown in Fig. 3. This is obtained by mounting the surface position indicating device according to the first embodiment on a fulcrum member 5. At least one of the arm members 1a and 1b is inserted into the fulcrum member 5, and the fulcrum member is movable in a longitudinal direction. Further, the fulcrum member 5 is rotatable about a rotation axis perpendicular to the surface of the plate-like member. Accordingly, it may be possible to position the observation window 2a, which is formed at the end of the arm member, at an arbitrary point on the surface of the plate-like member S. The movement of the fulcrum member is shown by arrows and a two-dot chain line. The detection of a defective portion existing on the surface of the plate-like member S and the detection and observation of a fine defective portion performed through the other observation window 2b are the same as those in the first embodiment.

[0014]

Meanwhile, if the fulcrum member 5 or the arm members 1a and 1b are provided with graduations or a sensor, it may be possible to read or record the defect position in the form of polar coordinates.

Third embodiment

A third embodiment of the invention is shown in Fig. 4. In this embodiment, two sets of the surface observation devices of the first embodiment are used as arms. Reference numeral 8 denotes a first rail, reference numeral 7 denotes a first block that slides on the first rail, and reference numeral 6 denotes a first arm that is mounted on the first block 7 in a direction orthogonal to the first rail 8 and includes a slit 61 having the same width over substantially the entire length thereof. For example, the first rail 8 is provided parallel to one side of the plate-like member S.

[0015]

Reference numeral 11 denotes a second rail, reference numeral 10 denotes a second block that slides on the second rail, and reference numeral 9 denotes a second

arm that is mounted on the second block 10 in a direction orthogonal to the second rail 11 and includes a slit 91 having the same width over substantially the entire length thereof. A square observation window 2 is formed at an intersection between the first and second arms 6 and 9. The detection of a defective portion existing on the surface of the plate-like member S that is performed through the observation window 2 positioned on the surface side of the plate-like member and the detection and observation of a fine defective portion that are performed through the observation window 2 positioned on the back side of the plate-like member are the same as those in the first embodiment. It is more preferable that an appropriate block be fitted to the observation window 2 and a lens 3 be fitted to the block. Letters a and b representing the surface side and the back side are omitted in Fig. 4. However, the fact that the arms positioned on the surface side and back side are formed of the same arm members is the same as those in the first and second embodiments.

[0016]

Meanwhile, if the first and second rails 8 and 11 are provided with graduations or sensors, it may be possible to read or record the defect position in the form of X-Y coordinates.

[0017]

Effects of the Invention

According to the invention, the same portion as the defect position, which is detected on the surface of a material to be inspected, is indicated by an observation window positioned on the back side of the material to be checked and can be observed in detail through a lens. Accordingly, it may be possible to obtain excellent advantages of early detecting the cause of the generation of a defect, taking measures, and improving the surface quality of a product.

Brief Description of the Drawings

Fig. 1

Fig. 1 is a perspective view of a first embodiment of the invention.

Fig. 2

Fig. 2 is a side view showing an example of use of the first embodiment of the invention.

Fig. 3

Fig. 3 is a front view of a second embodiment of the invention.

Fig. 4

Fig. 4 is a front view of a third embodiment of the invention.

Fig. 5

Fig. 5 is a conceptual view showing an example of a surface defect according to the invention.

Description of Symbols

1	arm member
2	observation window
3	lens
4	joint
5	fulcrum member
6	first arm
7	first block
8	first rail
9	second arm
10	second block
11	second rail
61, 91	slit
S	plate-like member